3rd Grade Unit 1: Pushes, Pulls and Invisible Forces

Content Area: **Science**
Course(s):
Time Period: **MP1**
Length: **25 days**
Status: **Published**

NJSLS - Science

3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
3-PS2-3	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
3-PS2-4	Define a simple design problem that can be solved by applying scientific ideas about magnets.

Science and Engineering Practices

Planning and Carrying Out Investigations

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1, 3-5-ETS1-3)

Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Asking Questions and Defining Problems

Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)

Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Define a simple design problem that can be solved through the development of an object, tool, process, or

system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Constructing Explanations and Designing Solutions

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

PS2.A: Forces and Motion

Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)

The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

PS2.B: Types of Interactions

Objects in contact exert forces on each other. (3-PS2-1)

Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depends on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3, 3-PS2-4)

ETS1.A: Defining and Delimiting Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

Research on a problem, such as climate change, should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Cause and Effect

Cause and effect relationships are routinely identified. (3-PS2-1)

Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Patterns

Patterns of change can be used to make predictions. (3-PS2-2)

Influence of Science, Engineering, and Technology on Society and the Natural World

People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)

Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks,

and meet societal demands. (3-5-ETS1-2)

Rationale and Transfer Goals

In this unit, students will become force investigators to explore how objects move, interact, and respond to the world around them. Students will begin by investigating contact forces, examining how balanced and unbalanced forces dictate an object's motion or rest. Through hands-on observations of everyday items like swings, pendulums, and rolling balls, students will identify, map, and predict patterns in future motion.

The unit then shifts from the visible to the invisible as students explore non-contact forces. Through inquiry-based setups, students will discover the cause-and-effect relationships of electric and magnetic interactions. They will observe how distance affects these forces and how objects can move without ever being touched. Concluding the unit with an engineering focus, students will apply their understanding of magnetic properties to define a real-world problem and design a practical solution. By the end of the unit, students will possess a foundational understanding of the unseen forces that govern our physical universe.

Enduring Understandings

An object’s motion is completely determined by the sum of the forces acting on it. When forces are balanced, an object will stay still or keep moving at the same speed; when forces are unbalanced, the object's speed or direction will change.

By carefully observing and measuring how things move over time, we can discover regular patterns. We can use these repeating patterns to accurately predict how an object will move in the future.

Forces do not always require physical contact to cause change. Some forces, like gravity, static electricity, and magnetism, can push or pull objects from a distance through invisible fields.

The power of a non-contact force depends on properties like distance and orientation.

Scientific knowledge about forces and magnets can be used by engineers to design creative solutions to real-world, everyday problems.

Essential Questions

How do forces change the way objects move?

How can we use patterns to predict how an object will move in the future?

How can an object move another object without even touching it?

How can we use the invisible power of magnets to solve everyday problems?

Content - What will students know?

- A force is a push or a pull that can cause an object to start moving, stop moving, or change direction.
- When forces acting on an object are balanced, they are equal in size and opposite in direction, resulting in no change in the object's motion (it stays still or keeps moving at a constant speed).
- When forces are unbalanced, they are unequal, causing the object to speed up, slow down, or change direction.
- The motion of objects (like a swinging pendulum, a see-saw, or a child on a slide) often follows regular, repeating patterns. These patterns can be observed, measured, and used to predict future motion.
- Forces can act on an object without physically touching it (magnetic, static electric, and gravitational forces).
- Magnets have two poles: a North pole and a South pole.
- Like poles repel (push away) each other (N-N or S-S), while opposite poles attract (pull together) each other (N-S).
- Magnets only attract certain types of metals (like iron, nickel, and cobalt).
- Rubbing certain materials together can create a static charge, causing them to push or pull other objects without touching them.
- The strength of both magnetic and electric forces changes with distance; the closer two objects are, the

stronger the push or pull.

- Problems can be solved by defining a need, brainstorming solutions, and using scientific properties (like magnetism) to create a tool or fix a problem.
- A successful design must meet specific rules (criteria) and stay within certain limits, like time, materials, or size (constraints).

Skills - What will students be able to do?

- Set up fair tests to show how different forces (pushes and pulls) change an object's speed or direction.
- Use simple tools (like rulers, timers, or grids) to measure an object's position and motion.
- Look at data from a moving object (like a swinging pendulum or a rolling car) to identify a repeating pattern.
- Use observed patterns to accurately predict where an object will be or how it will move next.
- Formulate cause-and-effect questions about how magnets work and how static electricity behaves.
- Observe and describe how magnets attract or repel each other based on their north and south poles.
- Conduct tests to show how the distance between two magnetic or electrically charged objects changes the strength of the force.
- Clearly explain a real-world problem that can be solved using magnets, including the criteria for success and the constraints (materials, time, size).
- Sketch, build, or prototype a simple device that uses magnetic force to solve the defined problem (e.g., a magnetic latch, a toy sorting system, or a tool to pick up dropped paperclips).
- Test their engineering design and suggest improvements based on how well the magnets performed.

Activities - How will we teach the content and skills?

- Mystery Science Invisible Forces Anchor Phenomenon
- Mystery Science Invisible Forces Lesson 1
- Mystery Science Invisible Forces Lesson 2
- Mystery Science Invisible Forces Lesson 3
- Mystery Science Invisible Forces Lesson 4

- Mystery Science Invisible Forces Lesson 5
- Whole group instruction and discussion.
- Read Alouds
- Group and Individual Projects
- Hands-on discovery when possible; creating models
- Webquests/Internet “field trips”

Formative Assessments

- Mystery Science Invisible Forces Lesson 1 Assessment
- Mystery Science Invisible Forces Lesson 2 Assessment
- Mystery Science Invisible Forces Lesson 3 Assessment
- Mystery Science Invisible Forces Lesson 4 Assessment
- Mystery Science Invisible Forces Lesson 5 Assessment
- Teacher Observation
- Student projects/models
- Exit Tickets

Summative Assessments

- Mystery Science Invisible Forces Unit Assessment
- Mystery Science Invisible Forces Performance Task
- Grade 3 Science Benchmark #1

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity

• Objects in contact exert forces on each other. • Each force that acts on a particular object has both strength and a direction. • An object at rest typically has multiple forces acting on it, but they add to zero net force on the object. • Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Qualitative and conceptual, but not quantitative, addition of forces are used at this level.) • Science findings are based on recognizing patterns. • Patterns of change can be used to make predictions. • The patterns of an object's motion in various situations can be observed and measured. • When past motion exhibits a regular pattern, future motion can be predicted from it. (Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)	Kindergarten: Pushes and pulls can have different strengths and directions. Kindergarten: Pushing or pulling on an object can change the speed or direction of the object's motion and can start or stop it. Kindergarten: When objects touch or collide, they push on one another and can change motion. Kindergarten: A bigger push or pull causes things to speed up or slow down more quickly. Kindergarten: Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	K-PS2-1 Activities K-PS2-2 Activities

Key Resources

Mystery Science

Robo Arm

Student Interactives

Career Readiness, Life Literacies, & Key Skills

9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).
9.2.5.CAP.1	Evaluate personal likes and dislikes and identify careers that might be suited to personal likes.
9.1.5.CR.1	Compare various ways to give back and relate them to your strengths, interests, and other personal factors.
9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
9.2.5.CAP.3	Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
9.2.5.CAP.4	Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
9.4.5.DC.4	Model safe, legal, and ethical behavior when using online or offline technology (e.g., 8.1.5.NI.2).
9.4.5.DC.8	Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).
9.4.5.IML.2	Create a visual representation to organize information about a problem or issue (e.g., 4.MD.B.4, 8.1.5.DA.3).
9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.
9.4.5.TL.2	Sort and filter data in a spreadsheet to analyze findings.
9.4.5.TL.3	Format a document using a word processing application to enhance text, change page formatting, and include appropriate images graphics, or symbols.

Interdisciplinary Connections

RI.CR.5.1	Quote accurately from an informational text when explaining what the text says explicitly

	and make relevant connections when drawing inferences from the text.
RI.MF.5.6	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, timelines, animations, or interactive elements on web pages) and explain how the information contributes to an understanding of the text in which it appears.
3.M.A.2	Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.
RI.CT.5.8	Compare and contrast the authors' approaches across two or more informational texts within the same genre or about texts on the same or similar topics.
RI.CR.3.1	Ask and answer questions and make relevant connections to demonstrate understanding of an informational text, referring explicitly to textual evidence as the basis for the answers.
W.WR.5.5	Establish a central idea about a topic, investigation, issue or event and use several sources to support the proposed central idea.
W.SE.5.6	Gather relevant information from multiple valid and reliable print and digital sources; summarize or paraphrase information in notes and finished work, making note of any similarities and differences among ideas presented; and provide a list of sources.
W.WR.3.5	Generate questions about a topic and independently locate related information from at least two reference sources (print and non-print) to obtain information on that topic.
W.SE.3.6	Use discussion, books, or media resources to gather ideas, outline them, and prioritize the information to include while planning to write about a topic.